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11. NOMENCLATURE AND TERMINOLOGY FOR ANALYTICAL PYROLYSIS (IUPAC RECOMMENDATIONS 1993)

Prepared for publication by

P. C. Uden, University of Massachusetts, Amherst, MA, USA

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Abstract

This paper defines terms and definitions used in analytical methods of pyrolysis and includes expressions for coupled systems and for the description of the temperature profiles and the products that are obtained.

Introduction

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Thermal degradation under controlled conditions is often used an part of an analytical procedure, either to render a sample into a suitable form for subsequent analysis by gas chromatography, mass spectrometry or infrared spectroscopy or by direct monitoring as an analytical technique in its own right. A range of terms and expression have been used in the field and this nomenclature brings these together in a systematic manner and assigns each a specific meaning.

Analytical Pyrolysis

Analytical Pyrolysis

The characterization, in an inert atmosphere, of a material or a chemical process by a chemical degradation reaction(s) induced by thermal energy.

Catalytic Pyrolysis

A pyrolysis that is influenced by the addition of a catalyst.

Char

A solid carbonaceous pyrolysis residue.

Coil Pyrolyser

A pyrolyser in which the sample (sometimes located in a tubular vessel) is placed in a metal coil that is heated to cause pyrolysis.

Continuous Mode (Furnace) Pyrolyser

A pyrolser in which the sample is introduced into a furnace preheated to the final temperature.

Curie-Point Pyrolyser

A pyrolyser in which a ferromagnetic sample carrier is inductively heated to its Curie point.

Filament (Ribbon) Pyrolyser

A pyrolyser in which the sample is placed on a metal filament (ribbon) that is resistively heated to cause pyrolysis.

Final Pyrolysis Temperature ($T_{(f,Py)}$)

The final (steady state) temperature which is attained by a pyrolyser. (The terms 'equilibrium temperature' and 'pyrolysis temperature' may be used when referring to an isothermal pyrolysis; they are not recommended for use with a non-isothermal pyrolysis.)

Flash Pyrolysis

A pyrolysis that is carried out with a fast rate of temperature increase, of the order of 10 000 K/s.

Fractionated Pyrolysis

A pyrolysis in which the same sample is pyrolysed at different temperatures for different times in order to study special fractions of the sample.

In-Source Pyrolysis

A pyrolysis in which the reactor is located within the ion source of a mass spectrometer.

IR-Pyrogram

Chromatogram of a pyrolysate detected by infrared spectrometry.

Isothermal Pyrolysis

A pyrolysis during which the temperature is essentially constant.

Maximum Pyrolysis Temperature ($T_{(max,Py)}$)

The highest temperature in a temperature/time profile.

MS-Pyrogram

Chromatogram of a pyrolysate detected by mass spectrometry.

Off-Line Pyrolysis

A pyrolysis in which the products are trapped before analysis.

Oxidative Pyrolysis

A pyrolysis that occurs in the presence of an oxidative atmosphere.

Pressure Monitored Pyrolysis

A pyrolysis technique in which the pressure of the volatile pyrolysates is recorded as the sample is heated.

Pulse Mode Pyrolyser

A pyrolyser in which the sample is introduced into a cold furnace which is then heated rapidly.

Pyrogram

A chromatogram of a pyrolysate.

Pyrolysate (Pyrolyzate)

The products of pyrolysis.

Pyrolyser (Pyrolyzer)

A device for performing pyrolysis.

Pyrolysis

A chemical degradation reaction that is caused by thermal energy. The term *pyrolysis* generally refers to an inert environment.)

Pyrolysis-Gas Chromatography (Py-GC)

A pyrolysis technique in which the volatile pyrolysates are directly conducted into a gas chromatograph for separation and detection.

Pyrolysis-Gas Chromatograph-Mass Spectrometry (Py-GC-MS)

A pyrolysis technique in which the volatile pyrolysates are separated and analysed by on-line gas chromatography-mass spectrometry.

Pyrolysis-Gas Chromatography-Infrared Spectroscopy (Py-GC-IR)

A pyrolysis technique in which the volatile pyrolysates are separated and analysed by on-line gas chromatography-infrared spectroscopy.

Pyrolysis-Infrared Spectroscopy (Py-IR)

A pyrolysis technique in which the pyrolysates are detected and analysed by on-line infrared spectroscopy.

Pyrolysis-Infrared Spectrum

Infrared spectrum obtained from *pyrolysis-infrared spectroscopy*.

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Pyrolysis-Mass Spectrometry (Py-MS)

A pyrolysis technique in which the volatile pyrolysates are detected and analysed by on-line mass spectrometry.

Pyrolysis-Mass Spectrum

Mass spectrum obtained from *pyrolysis-mass spectrometry*.

Pyrolysis Reactor

That portion of the pyrolyser in which the pyrolysis takes place.

Pyrolysis Residue

That portion of the pyrolysate that does not leave the reactor.

Pyrolysis Thermogram

The result of a temperature programmed pyrolysis in which the detector signals, e.g. total ion current or single ions, total absorbance or a GC-detector, are plotted against time or temperature.

Reductive Pyrolysis

A pyrolysis which occurs in the presence of a reducing atmosphere.

Sequential Pyrolysis

A pyrolysis in which the same initial sample is repetitively pyrolysed under indentical conditions (final pyrolysis temperature, temperature rise time and total heating time).

Stepwise Pyrolysis

A pyrolysis in which the sample temperature is raised stepwise. The pyrolysis products are recorded between each step.

Tar

A liquid pyrolysis residue.

Temperature-Programmed Pyrolysis

A pyrolysis during which the sample is heated at a controlled rate within a temperature range in which pyrolysis occurs.

Temperature Rise Time (TRT)

The time required for a pyrolyser temperature to be increased from its initial to its final temperature.

Temperature Time Profile (TTP)

A graphical representation of temperature *versus* time for a particular pyrolysis experiment or pyrolyser.

Total heating time (THT)

The time between the onset and conclusion of the sample heating in a pyrolysis experiment.

Volatile Pyrolyzate

That portion of the pyrolystate which has adequate vapour pressure to reach the detector.

List of Symbols

$T_{(f,Py)}$	Final pyrolysis temperature
$T_{(max,Py)}$	Maximum pyrolysis temperature

Index of Acronyms

Py-GC	Pyrolysis-gas chromatography
Py-GC-IR	Pyrolysis-gas chromatography-infrared spectroscopy
Py-GC-MS	Pyrolysis-gas chromatography-mass spectrometry
Py-IR	Pyrolysis-infrared spectroscopy
Py-MS	Pyrolysis-mass spectrometry
THT	Total heating time
TRT	Temperature rise time
TTP	Temperature time profile

12A. NOMENCLATURE

Chromatography (IUPAC Recommendations 1993)

Prepared for publication by

L. S. Ettre, Yale University, New Haven, CT, USA

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